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SCIENCE

FRIDAY AUGUST 20, 1920

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THE COOPERATIVE COURSE IN ELECTRICAL ENGINEERING AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

FOR the past year the Massachusetts Institute of Technology and the General Electric Company have conducted a cooperative course in electrical engineering, which has proved unusually successful. In this course, a logical working out of the underlying principles has led to several interesting innovations in the conduct of the work. In brief the scheme is as follows:

The course covers a total of five years, the first two being identical with the regular course in electrical engineering at the institute, the last three being divided between instruction in theory at the institute and practise at the Lynn works of the General Electric Company. The instruction at the institute during the first four years of the cooperative course is similar in method and content to the general course in electrical engineering at the institute with certain omissions and abridgments for which equivalents are provided at the works. The work of the final or fifth year comprises postgraduate research work and training in design. Training at the works is also conducted with a primary view to its educational value and is closely correlated with the instruction in theory. During the final year of this course considerable latitude may be exercised by the students in the selection of their line of work, assignments being made either to shop management in the works' office or to research in the company's research laboratories, depending upon the aptitudes and preferences of the individual students.

The schedule of the cooperative years, *i. e.*, the last three years, is as follows:

The year (12 months) is divided into four three-month periods, the students spending

alternately thirteen weeks at the Lynn works of the General Electric Company and eleven weeks at the institute followed by a two weeks' vacation. Compensation is paid by the General Electric Company to students in this course at an hourly rate which considerably more than pays for their tuition. For a successful completion of the course, the institute confers the degrees of Bachelor of Science and Master of Science.

The educational concept upon which the course is founded combines the rudiments of Spencer's theory of education with the central idea of Josiah Royce's. It is an endeavor to develop simultaneously all the desirable sides of an engineer's mind, character and body and at the same time inculcate in him the spirit of loyalty to his life's work. The course was planned so that these several activities are carried on uninterruptedly throughout the cooperative period. Thus, throughout those periods spent at the works as well as those at the institute, instruction is given in theory, classes are conducted in some humanistic study, time is given and facilities provided for collateral reading, and arrangements are made for systematic physical exercise and recreation. The change therefore, at the end of each period, does not mean so much a change in occupaton as a change in the subjects upon which greatest emphasis is laid.

To facilitate the carrying out of these ideas, the General Electric Company has provided a club house where all the students are housed during their sojourn at Lynn. Here classes in theory of electrical engineering and general studies are conducted. Here the men get to know the full meaning and value of teamwork in play and cooperation in business. Life here is very much like that of a small fraternity with its opportunities for quiet study and recreation. A small library is provided consisting of a collection of technical books and works of interest to the engineer, and also of nearly one hundred volumes from the Lynn Public Library upon more general subjects and in divers fields of literature.

Everything at the club house tends to lessen the sense of separation from the institute and to make the men feel that they still have a part in the activities and student life at Technology. In the works, the students are also made to feel the controlling presence of the institute. On three or four days each week, a member of the staff of the electrical engineering department of the institute spends a half day at the plant in the various shops and offices in which the students are assigned. The student is thus ever conscious of the supervision which the institute exercises over his work even in the shop.

It is in this particular method of supervision, that the Technology cooperative course differs from others. The General Electric Company is doing some real cooperation in the training of manufacturing engineers. The company recognizes that for three years these students are placed in its plant for the prime purpose of being educated and trained as electrical engineers of a particularly high grade and specially informed in manufacturing practise. It has been clearly understood that these students are in the shops and offices to learn and learn thoroughly manufacturing methods. Because he can best obtain this knowledge by actually doing the work himself, and because the skill which he attains in any process is the only fair indication of his knowledge of that process, the student is put on the company's pay roll and becomes a part of its organization. The length of time spent in each of the work's departments is regulated not by the needs of that department but by the value of the experience to the students. As soon as it is deemed that a student has sufficient knowledge of the details in one department he is changed to another. The cooperative students work as earnestly and consistently as the other men in the various departments, as is shown by the reports from the foremen. They are graded on the amount and quality of the work which they do in the various shops and thus the inducement to do good work is as strong in them as in the regular workmen. This spirit of genuine cooperation on the part of the cooperating company, it seems to me, is a fundamental contribution which the Tech-

nology cooperative plan offers to engineering education.

The officials of the company confess that they expect to be the gainers by this policy. Already there is an abundant evidence that their hopes will be realized. The students have been thrown together in a very intimate relationship at the club house and have developed an intense loyalty to one another and to the course which they are pursuing.

There remains to be mentioned the effect which this plan of study has upon the mental condition of the student and upon his progress in acquiring theoretical knowledge. The members of the instructing staff who have come in contact with these students on their return from Lynn are almost unanimous in reporting that they show an increased mental alertness, a greater fund of information concerning all matters connected with their profession, and a wider interest in things in general. That the General Electric Company considers this educational experiment a success is evidenced by the fact that they have raised next year's limit of forty to sixty students. The fact that the applications for next year's class are five times as great as they were last year is some indication of how nearly the course has met the students' anticipations.

Thus, although the plan has been in operation for one year only, it has already gained the approval of the three parties most vitally concerned: the students, the institute, and the cooperating company.

WILLIAM H. TIMBIE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PARALLEL MUTATIONS IN THE OSTRICH

THE account by Dr. A. H. Sturtevant of a mutation (notch) in *Drosophila funebris* similar to one which has occurred several times in *D. melanogaster* recalls the following sentence in Darwin's "Origin," p. 179: "As all the species of the same genus are supposed, on my theory, to have descended from a common parent, it might be expected that they would occasionally vary in an analogous manner."

The problem of parallel mutations has lately been impressed upon one by certain conditions met with in the two-toed African ostrich, *Struthio*. Four species of the genus have been described, among which the most distinctive are the North African ostrich, *S. camelus* Linn., and the South African, *S. australis* Gurney. Owing to a recent importation by the Union Government of South Africa of over a hundred specimens of the northern bird which have been placed in charge of the writer a unique opportunity has presented itself of studying the northern and southern ostrich side by side and also of observing the behavior of their characters in cross-breds.

Well-marked characters separate the two species. The most important are: a difference in size, especially as regards the length of the legs and neck; a different skin coloration from the chick onwards, culminating in a conspicuous contrast between the cocks at the nuptial season; a bald patch on the head of the northern bird, that of the southern being covered with short, hair-like feathers; and differences in the size and shape of the egg, accompanied by a pitted surface in the one and an ivory smoothness in the other. The characters represent germinal differences, those of the imported birds being retained under the new environmental conditions and reappearing in all the progeny which have been hatched. The birds cross freely and in the first generation hybrids (F_1) the bald patch is found to be dominant, appearing in all the hundred or more crosses reared, while the dimensions and colors of the body and the features of the egg appear as intermediates of varying degree. Sufficient time has not intervened for the rearing of many second generation hybrids, (F_2) only two having yet been obtained. They however give every reason to expect that segregation of the characters will take place in the second generation. In what ever manner this may occur there can be no

[1] "A Parallel Mutation in *Drosophila funebris*," SCIENCE, July 19, 1918.

question that the specific features are the expression of distinct factorial differences in parts of the germ plasm of the northern and southern ostrich.

Like most of the Ratitæ the two-toed ostrich is degenerate in some respects and highly specialized in others, compared with ordinary flying birds. Degeneration is especially indicated by the small size of the wings and the practical absence of feathers from their under surface and specialization (degeneration) by the reduction in the number of toes. The development and progress of ostrich farming in South Africa had produced prior to the war about a million domesticated birds which afford an abundance of living specimens for examination, now supplemented by the importation already mentioned as well as by much embryological material. The result has been the demonstration that the ostrich is undergoing slow degeneration in numerous directions in connection with its plumage, wings and legs, survivals of practically all stages in the process being procurable.

The principal directions along which plumage degeneration is taking place include the general under-covering of the wings, the single row of under-coverts, the remiges or wing quills, the second and higher rows of upper-coverts, the feathers covering part of the leg and the under-covering of down. The third digit of the wing exhibits important evolutionary stages, while in addition to the loss of the first, second and fifth toes of the foot it can be shown that the small fourth is also in process of disappearance, particularly as regards its claw. Losses of the scales over the big middle toe reveal that retrogression has already begun on what will in time be the only remaining toe. In any individual bird the changes in any one direction take place quite independently of those in the other directions, and all proceed in a definitely determinate manner which is the same for all the representatives of the two species. The experiments already carried out serve to establish that the losses are factorial in their nature and that in crosses they follow strictly Mendelian lines. They are to be regarded as retrogressive mutations resulting from the dropping out of factors, the changes proceeding in regular succession along various directions, the succession being particularly impressive in the case of the gradual loss of plumes from certain of the rows of feathers and in the digits of the foot (*rectigradations* Osborn[2]). It is highly questionable if up to the present any selection value can be attributed to any of the changes.

The present interest lies in the fact that the mutative changes are common to the germ plasm of both the northern and the southern ostrich and are taking place in one independently of the other. They may indeed be presumed to be the same throughout the continent, suggesting that they are intrinsic in their nature and independent of environmental influences. If we regard the two species of ostriches as distinct then we can understand how the term parallel mutations may be applied to the changes going on in both, but at the same time it may appear to carry with it the notion that similar mutations are proceeding in two disconnected and independent germ plasms. If, on the other hand, we retain the idea of the origin of species from a common stock which Darwin had in his mind in the quotation given, then it becomes more in harmony with fact to think of the changes as taking place in germ plasm of the same nature and of a common genetic origin.

We must conceive the germ plasm to be fundamentally the same for the African ostrich as a whole, though certain changes have taken place in parts of it which give us the differences delimiting the species. On this view it is easy to comprehend how the same mutative changes will occur in what for the sake of convenience we now distinguish as two species. The mere fact that one assemblage of ostriches is bald-headed, larger and differently colored as compared with another and that the hens lay a different egg indicates only slight differences in the germinal make-up of the birds. In both the constituents of the

[2] *Amer. Nat.*, August, 1917.

germ plasm controlling the plumage and the structural details of the wings and legs remain unchanged, and it is in these that we have similar degenerative changes in progress. In studying the small differences which distinguish species we may overlook the main essentials in which they agree.

The individuality and separability of the germ factors in the ostrich are well exemplified in the fact that while differential changes have taken place in some respects common changes have taken and are taking place in other respects. We may respectively designate as parallel the mutation found in the two species of *Drosophila* and the numerous ones met with in the two species of *Struthio,* because they occur in different species, but it must be with the understanding that the changes proceed in similar parts of the germ plasm which are common to both, and would go on were there no specific differences.

Whether parallel mutations ever occur in germ plasms not genetically related may well be doubted. It may be that similarity of changes always implies similarity of origin in corresponding parts of the germ plasm. There is abundant evidence that the fourth, outer toe of the ostrich is well on the way towards disappearance, and when this is effected we shall have only the single middle toe in two such widely separated animals as the ostrich and the horse. While to institute a close comparison of the limbs of the two animals seems to strike at the roots of our morphological ideas it may well be that the degeneration in the toes of *Struthio* is an expression of changes in its germ plasm of a fairly similar nature to those which have been effected in the germ plasm of *Equus,* and is referable to separable parts of the germ plasm which the two have or had in common. All that this involves however is the recognition of the fact that the fundamental parts of the limbs of digitate vertebrates take their origin from corresponding parts of the germ plasm common to all. Osborn[3] must have had occurrences of this kind in mind when he wrote: "Similar rectigradations may arise in all the descendents of similar ancestors at different periods of time; they always give rise to parallelism or convergence between the members of related phyla." To go beyond digitate limbs, we may presume that the characteristics of the chordate phylum—dorsal tubular nervous system, notochord, visceral arches and clefts—arise from separable parts of the germ plasm which are common to all the members of the phylum, and distinct from other parts which give rise to the characters serving to distinguish the classes of the chordates.

In whatever way we conceive the germinal changes to be going on in the two-toed ostrich it is clear they are not limited to the African genus *Struthio* among the flightless birds. For we have degenerative changes of a fairly similar nature represented in the three-toed American ostrich (*Rhea*) and in the wing of the New Zealand *Apteryx,* while the *Moas* had apparently lost their wings altogether before becoming extinct. Where exactly similar, these may be termed parallel mutations, but it seems more in harmony with modern genetical ideas to think of them as taking place in separate parts of the germ plasm which the sub-class has in common. In the Ratitæ as a whole we seem to have one of those groups of animals, so often represented in the evolutionary series, in which high specialization in certain directions is accompanied by marked decadence in other respects and which in the end result in extinction. When they are alike the changes may be described as parallel mutations, but it is sought to emphasize that they take place in a similar manner in those parts of the germ plasm which the group has genetically in common.

Though the living representatives are so widely separated, the germ plasm controlling the plumage, wings and legs of the Ratitæ as a whole is manifestly subject to some common intrinsic influence which expresses itself in the gradual loss of these structures, the process proceeding more rapidly in some than in others and sometimes modified in different ways. Many of the facts of degeneration presented by the ostrich incline one to attribute

[3] *Amer. Nat.,* April, 1915.

the changes to a slow reduction of factorial potency, culminating in complete factorial loss. While in by far the majority of forms of life the germ factors are static, may there not be others in which certain of the factors are increasing in potency and some in which they are dwindling?

J. E. Duerden

Rhodes University College,
Grahamstown, South Africa

SCIENTIFIC EVENTS

CENTRAL HEADQUARTERS FOR BRITISH CHEMISTS

At a dinner held in honor of Lord Moulton on July 21, Sir William Pope announced that a public appeal was about to be made for funds for the erection of central headquarters for British chemistry. According to a statement in *Nature* none of the chemical bodies has the accommodation for a meeting of more than two hundred persons, or adequate library space. The Chemical Society conducts its business at Burlington House, Piccadilly, in rooms provided by the government nearly fifty years ago, when the membership was about one fifth of what it is to-day. The Institute of Chemistry possesses a good building in Russell Square, completed during the first year of the war, but it is barely adequate for the present activities of the institute, which has to look to colleges for hospitality for any general meeting of unusual interest and for lectures. The Society of Chemical Industry and the Society of Public Analysts hold their meetings at the Chemical Society's rooms. Neither of these bodies nor any other which is concerned with chemistry, such as the British Association of Chemical Manufacturers, the Faraday Society, the Biochemical Society, and those devoted to the various branches of technology—brewing, dyes, glass, ceramics, iron and steel, non-ferrous metals, leather, concrete, petroleum, and so forth—possesses accommodation to compare with the spacious halls and headquarters of the Institutions of the Civil, the Mechanical, and the Electrical Engineers, and of the Royal Society of Medicine.

The appeal, which will be made by the Federal Council for Pure and Applied Chemistry, on which practically all the chemical interests of the country are represented, has the cordial support of Lord Moulton, who, as director-general of the explosives supplies, ministry of munitions repeatedly acknowledged the services rendered during the war by these scientific, technical, and industrial bodies.

The scheme, which aims at providing under one roof, so far as is practicable, a common meeting place, library, and editorial facilities for technical journals, is highly desirable, and indeed imperative, as a matter of supreme importance to the welfare of the whole country in relation to questions of defence and the maintenance and development of all branches of industry and commerce which depend on the applications of chemistry. The sum required for building is estimated at £250,000; a similar sum is required for establishing a chemical library and to provide for the compilaton and production of works of reference in the English language.

FORESTRY EDUCATION

The British Empire Forestry Conference, which met in London during July adopted the following resolutions on forestry education, which the delegates are to bring to the notice of their respective governments:

It should be a primary duty of forest authorities throughout the empire to establish systematic schemes of forest education. It has been found, for climatic and other reasons, that it would not be possible for each part of the empire to establish a complete scheme of forestry education of its own, and therefore it is essential that those parts of the empire which are willing and able to establish complete systems should, as far as possible, frame such schemes with a view to combining for meeting the needs of those parts which can only themselves make a partial provision for their requirements. Part of this subject has been dealt with by a committee, whose report, which refers mainly to the higher training of forest officers, is approved by the conference. The main principles embodied in this report are as follows:

1. That one institution for training forest officers be established in the United Kingdom.

2. That students be selected from graduates hav-

ing taken honors in pure or natural science at any recognized university.

3. That it be an integral part of the work of the institution to arrange supplementary courses at suitable centers for students requiring special qualifications and also special courses for forest officers from any part of the empire, whether at the institution or at centers of training in other parts of the world. The governments should recognize these courses as part of the ordinary duties of the forest officers, at any time during their service, and the governments concerned should give special facilities to forest officers in their service to attend such courses.

4. That a department of research into the formation, tending, and protection of forests be associated with the training institution.

5. That encouragement should be given to the existing provision made by universities and colleges for forestry instruction for those who do not desire to take the full course suggested for the forestry service. It appears that this is especially applicable to the United Kingdom. It is also desirable to make adequate provision for woodmen's schools for the training of foresters as distinct from those which are intended for forest officers.

SCHOLARSHIPS IN MEDICAL SCHOOLS

ACCORDING to the *Journal* of the American Medical Association 348 scholarships are reported this year in the following thirty-eight medical schools:

University of Alabama School of Medicine, Mobile	67
Leland Stanford Junior University Medical School*	3
University of California Medical School,* San Francisco	3
University of Colorado School of Medicine,* Boulder	1
Yale University School of Medicine,* New Haven, Conn.	2
Hahnemann Medical College and Hospital of Chicago*	6
Loyola University School of Medicine, Chicago.	3
Rush Medical College, Chicago	7
University of Illinois College of Medicine,* Chicago	7
Indiana University School of Medicine, Indianapolis	12
State University of Iowa College of Medicine.	1
University of Kansas School of Medicine*	17
Johns Hopkins University Medical Department, Baltimore	6
University of Maryland School of Medicine,* Baltimore	6
Harvard Medical School,* Boston	30
Boston University School of Medicine*	50
Detroit College of Medicine and Surgery	8
Washington University Medical School, St. Louis	4
Dartmouth Medical School,* Hanover, N. H.	2
University of Buffalo Department of Medicine*	1
University of Cincinnati College of Medicine.*	12
Western Reserve University School of Medicine, Cleveland	1
University of Oregon Department of Medicine,* Portland	3
Hahnemann Medical College and Hospital of Philadelphia*	12
Jefferson Medical College of Philadelphia.	2
Temple University Department of Medicine, Philadelphia	3
University of Pennsylvania School of Medicine,* Philadelphia	4
Woman's Medical College of Pennsylvania,* Philadelphia	24
Medical College of the State of South Carolina, Charleston	8
University of Tennessee College of Medicine, Memphis	14
Vanderbilt University Medical Department, Nashville, Tenn.	4
Baylor University College of Medicine, Dallas, Texas	5
University of Texas Department of Medicine,* Galveston	1
University of Wisconsin Medical School*	6
University of Vermont College of Medicine*	1
Medical College of Virginia, Richmond	10
University of Virginia Department of Medicine,* Charlottesville	2
Total in 38 medical schools	348

Besides the twenty-one colleges marked by an asterisk in the above list which have loan funds for deserving but needy students, such funds are available also at the six following medical schools:

College of Medical Evangelists, Loma Linda, Calif.
Tulane University of Louisiana School of Medicine, New Orleans, La.
University of Missouri School of Medicine, Columbia, Mo.

University of Nebraska College of Medicine, Omaha, Neb.
Wake Forest College School of Medicine, Wake Forest, N. C.
University of North Dakota School of Medicine, University, N. D.

CHICAGO MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE fall meeting of the American Chemical Society will be held with the Chicago Section, September 6 to 10 inclusive. The preliminary program assures a meeting which you can not afford to miss. The Chicago Section, by far the largest west of the Alleghenies, is arranging details of entertainment in their usual vigorous manner and one of the largest and most interesting meetings ever held is surely in view. Let every member who can be present.

Registration will begin during the morning of September 7 at the Congress Hotel. Information Bureau will be located at the hotel, and competent guides will be stationed at all the railroad depots. Tickets for the banquet, smoker and excursions will be obtained at the registration desk. Please give the matter of registering and obtaining tickets your first attention, as this will render our hosts a courtesy that will be appreciated. Tuesday afternoon a special registration desk will be placed in the Northwestern University Gymnasium.

The general program is as follows:

Monday, September 6

12.30 P.M.—Luncheon to the directors and advisory committee of the American Chemical Society by the directors of the Chicago Chemists Club.

4 P.M.—Council meeting.

6.30 P.M.—Dinner to the councilors by the Chicago Section.

8.15 P.M.—Council meeting resumed.

Tuesday, September 7

10 A.M.—General meeting of the society, Gold Room, Congress Hotel. Registration during the morning.

Addresses of Welcome—Dr. Julius Stieglitz, Honorable chairman of the convention and a representative of the Chicago Association of Commerce.

Response—President W. A. Noyes.

Two main addresses of thirty minutes each, one by a prominent local business man and the other by a scientist of national standing.

1.15 P.M.—Entrain for Evanston.

3.15 P.M.—Continuation of general meeting of the society in the Northwestern University Gymnasium.

Addresses—"Relation of educational institutions to the industries," Professor H. P. Talbot. "Some uses of silica gels," Professor W. H. Patrick.

4.30–10 P.M.—Combined men and ladies entertainment and reception, garden party, and beach party, including outdoor picnic dinner and smoker, band and orchestra concerts and organ recital, swimming, dancing, singing, sports and a special evening program.

Wednesday, September 8

9 A.M.—Divisional meetings at the University of Chicago.

12–2 P.M.—Luncheon at the Edelweis Gardens.

2 P.M.—Excursions—to Sherwin Williams Paint Co., Carter White Lead Co., Libby, McNeil and Libby Canning Plant, Pullman Car Co., Doehler Die Casting Co. Assemble at Van Buren St. Station of I. S. at 2.

6.30 P.M.—Alpha Chi Sigma Dinner.

8 P.M.—Presidential address: "Chemical Publications," Professor W. A. Noyes.

Thursday, September 9

9 A.M.—Divisional meetings, University of Chicago.

12–2 P.M.—Luncheon.

2 P.M.—Divisional meetings.

4 P.M.—Meeting of chairmen and secretaries of local sections.

7 P.M.—Banquet at Congress Hotel.

Friday, September 10

Excursions to Geary Iron Foundries Co., Fansteel Co., Lindsay Light Co., Carnotite Reduction Co., National Malleable Castings Co. (number limited). Others to be announced.

Titles for papers should be first sent to the secretary of the appropriate division or section and not to the secretary of the society. Titles to appear on the final program must be in the hands of the individual secretaries not later than August 21. The following are the

addresses of the divisional and sectional secretaries:

Divisions:

Agricultural and food chemistry: T. J. BRYAN, 4100 Filmore St., Chicago, Ill.

Biological chemistry: A. W. DOX, cr. Parke, Davis & Co., Detroit, Mich.

Dye section: R. NORRIS SHREVE, 43 Fifth Ave., New York, N. Y.

Fertilizer chemistry: H. C. MOORE, 209 W. Jackson Blvd., Chicago, Ill.

Industrial and engineering chemistry: H. E. HOWE, Marine Biological Laboratory, Woods Hole, Mass.

Organic chemistry: ROGER ADAMS, University of Illinois, Urbana, Ill.

Pharmaceutical chemistry (medicinal products chemistry): EDGAR B. CARTER, 2615 Ashland Ave., Indianapolis, Ind.

Physical and inorganic chemistry: H. N. HOLMES, Severance Chemical Laboratory, Oberlin, O.

Rubber chemistry: ARNOLD H. SMITH, Goodyear Tire & Rubber Co., Akron, Ohio.

Water, sewage and sanitation: W. W. SKINNER, Bureau of Chemistry, Washington, D. C.

Sections:

Leather chemistry: WILLIAM KLABER, 613 North Third St., Newark, N. J.

Sugar chemistry: FREDERICK J. BATES, Bureau of Standards, Washington, D. C.

Members who are to read papers having a popular appeal are requested to send synopses of them for the use of the A. C. S. News Service, care of American Chemical Society, 1 Madison Ave., Room 344, Metropolitan Bldg. (Tower) New York City, which, in cooperation with the local publicity committee, will conduct the press room. A short abstract (about 100 words) should be sent with the title of papers or handed to the secretary of your division at the time of presentation, so that it may appear in SCIENCE, if you wish your paper to have publicity or to obtain priority through this publication.

The final program will be sent about September 1 to all members who before August 29 have signified their intention of attending the meeting; to the secretaries of sections; to the council; to members of the Chicago Section, and to all members making special request therefor by mailing a postal card to this office direct.

CHARLES L. PARSONS,
Secretary
1709 G STREET, WASHINGTON, D. C.

SCIENTIFIC NOTES AND NEWS

DR. GEORGE ELLERY HALE, director of the Mount Wilson Observatory, has been elected one of the twelve foreign members of the Società Italiana delle Scienze, in succession to the late Lord Rayleigh.

PROFESSOR RAYMOND PEARL, of the Johns Hopkins University, has been decorated by the King of Italy as Knight of the Crown of Italy.

A MARY KINGLSEY medal has been awarded by the Liverpool School of Tropical Medicine to Ch. Wardell Stiles, of the United States Public Health Service, for his work on the eradication of hookworm disease.

SIR W. J. POPE has been elected an associate of the section for the mathematical and physical sciences of the Royal Belgian Academy.

THE first gold medal given by the Institution of Sanitary Engineers was presented at the annual summer meeting of the institution to Major A. J. Martin "for his services in originating health week and in the development of civil and military sanitation before and during the war."

MR. G. W. MOREY, of the Geophysical Laboratory, Carnegie Institution of Washington, who has been on leave of absence in charge of the optical glass plant of the Spencer Lens Company of Buffalo, N. Y., since November, 1918, has returned to his research work at the laboratory.

MR. M. J. PROFFITT, formerly of the Great Western Sugar Company, Denver Colorado, has been put in charge of sugar technology at the Bureau of Standards.

MR. FRIEND LEE MICKLE, bacteriologist of the Bureau of Laboratories of the Connecticut State Department of Health, has been appointed director of laboratories for the Bureau of Health of Atlantic City, N. J.

Dr. Waldemar T. Schaller has severed his connection with the Great Southern Sulphur Co., Inc., of New Orleans, La., and has returned to the United States Geological Survey, Washington, D. C.

Professor Charles J. Chamberlain, of the University of Chicago, has been invited to deliver a lecture on Cycads before the Botanical Section of the British Association for the Advancement of Science. He goes as the guest of the association, which meets at Cardiff, Wales, on August 24.

Professors L. E. Dickson, of the University of Chicago, and L. P. Eisenhart, of Princeton University, have been elected delegates of the American section of the International mathematical union to attend the meeting of the union at the University of Strasbourg beginning September 18, 1920.

Dr. F. Burt Wolbach, of Harvard Medical School, who has been abroad for six months in an effort to establish definitely the organism causing typhus, has returned to the United States.

Dr. Arturo Garcia y Casariego, assistant professor of pathologic anatomy and histology of the School of Medicine of the University of Havana, has been designated by the government to make a trip abroad to study matters relating to the teaching of these subjects. Dr. Gillermo Díaz y Macias, professor of practical pharmacy, has been commissioned to study the organization of pharmacologic laboratories abroad.

The Harveian Oration of the Royal College of Physicians, London, will be delivered by Sir Frederick Andrews on October 18; the Horace Dobell lecture by Sir William Leishman on November 2; the Bradshaw lecture by D. R. C. B. Wall on November 4; and the FitzPatrick lectures on the History of Medicine by Dr. E. G. Browne, of Pembroke College, Cambridge, November 9 and 11.

It is stated in *Nature* that the Rayleigh Memorial Committee has decided that the memorial to the late Lord Rayleigh in Westminster Abbey shall take the form of a mural tablet to be erected near the memorials to Sir Humphry Davy and Dr. Thomas Young. The execution of the tablet will be entrusted to Mr. Derwent Wood. It is expected that after all expenses are met there will be a balance remaining, and this the committee proposes shall be used to establish a library fund at the Cavendish Laboratory, Cambridge, with which Lord Rayleigh was closely associated.

Dr. Walter Faxon, in charge of mollusca and crustacea in the Museum of Comparative Zoology of Harvard University, from 1886 until about five years ago, and previously assistant professor of zoology at the university, died on August 10. Dr. Faxon graduated from Harvard College in the class of seventy-one.

The death is announced of Professor Felix Guyon, a former president of the Paris Academy of Medicine, head of the Hôpital Necker and known for his work on the diseases of the urino-genital organs.

The *Bulletin* of the American Mathematical Society announces the following deaths among mathematicians: Professor P. van Geer, on October 3, 1919, at the age of seventy-eight years; Professor M. Haid, of the Karlsruhe technical school, on November 15, 1919; Professor A. Boersch, at Homburg; Professor R. Heger, at Dresden, at the age of seventy-three years; Professor Paul Stäckel, of the University of Heidelberg, on December 13, at the age of fifty-seven years; Professor R. Malstroem, of the department of mechanics at the technical school at Helsingfors.

The United States Civil Service Commission announces for September 21, 1920, an open competitive examination for Naturalist on the Steamer *Albatross* in the Bureau of Fisheries at $2,200 a year with a possible bonus of $20.00 a month. Competitors are not required to report for examination at any place but will be rated on education, experience and thesis or publication. Further information may be obtained by application to the Civil Service Commission, Washington, D. C.

A first-hand study of Alaskan reindeer and land fur-bearing animals is now being made

by Dr. E. W. Nelson, chief of the Biological Survey, United States Department of Agriculture, and several specialists belonging to the staff of the bureau. Dr. Nelson will spend from two to three months in Alaska, while the other specialists will be in Alaska under permanent appointment acquiring information which will be valuable in the administration of new duties assigned to the Department of Agriculture by recent acts of Congress, namely, the improvement of reindeer herds as a source of meat in the Territory, fox farming, and the protection of land fur-bearing animals. One of the men accompanying Dr. Nelson—Dr. Seymour Hadwen—was formerly connected with the health of animals branch of the Canadian department of agriculture. He and a new member of the the staff, formerly connected with the Alaska Reindeer Service of the Department of the Interior, are devoting their attention to diseases among the reindeer. Two other members of the party, formerly grazing examiners with the Forest Service, are investigating the grazing areas of Alaska to determine the regions best suited to the reindeer.

THE timber on the Tongass National Forest in Alaska is said in a report issued by the United States Forest Service to be of particular importance in connection with the paper situation. It is estimated that there are about seventy billion board feet in Sitka, spruce and western hemlock well suited for paper making. The timber is located in a comparatively narrow belt along some 1,200 miles of coast line. Water power is available, as is also deep water transportation from numerous mill sites. It is estimated that the cut from this region alone would insure a perpetual supply large enough to meet one half of the present newsprint requirements of the United States. Alaska is one of the centers to which the newsprint industry of the United States should look for a large future development, says the report. The same is true of centers in the west where immense resources of pulp wood supply are now almost wholly undeveloped. Much of this timber is in the national forests. To bring about properly the development of the pulp and paper industry in new regions of abundant timber supplies the report recommends a comprehensive survey to furnish exact information upon the stand and location of suitable timber and other needed data.

IN connection with the meeting of the American Ornithologists' Union in Washington, D. C., this year, the local committee plans to hold an exhibit showing the history and development of zoological illustration as applied to birds, including original drawings, paintings and photographs. The pictures, which may be mounted on cards, but not framed, will be exhibited under glass in the Library of Congress where the exhibit will be held together a month or more. So far the consensus of opinion is that to keep the exhibit within bounds, each artist shall be limited to original drawings or paintings and each photographer to 2 prints.

AN advisory council for the Board of Surveys and Maps was organized, at a meeting held in Washington, Monday, July 12, to serve as an agency through which the Board can reach the map-using public and the public offer suggestions or criticisms regarding the work of the various bureaus of the Federal Government engaged in making surveys and maps. The Board of Surveys and Maps has greatly increased the cooperation between the different government bureaus and has established a central office from which information may be obtained regarding any map published by any government bureau. It remains for the public to utilize the facilities offered in the same spirit of cooperation. The advisory council consists of twenty or more representatives of the various national engineering, scientific, and map-issuing associations of the country who are interested in improving the efficiency of the government map-making agencies and the character and usefulness of the maps produced. It is hoped that suggestions of unmet needs, improvements in technique, or ways in which the government maps and engineering information can be made more useful to the map-using citizens

of the country will be sent to the officers of the Council, Edward B. Mathews, chairman, National Research Council, or A. G. Seiler, secretary, Touring Bureau, A. A. A., Riggs Building, Washington, D. C.

The annual meeting of the Society for Extending Rothamsted Experiments was held on June 18 at Rothamsted, Harpenden. Mr. J. F. Mason presided. It was reported by Dr. E. J. Russell, director, that the work of the station had again become normal. The staff was now complete, and operations active in all departments. The staff of the station at present numbers 70, and there are large laboratories and a 300-acre farm. The Ministry of Agriculture has now asked that the station shall undertake the study of the diseases of plants, and although the work has been begun the present facilities are quite inadequate. It is proposed to buy an adjoining site to build there a special laboratory for this work. For this £4,000 is needed, and half will be provided by the government. The remainder has to be found privately, and a fourth of the amount has already been subscribed.

According to an Associated Press despatch an expedition fitted out by the Swedish Society of Anthropology and Geography of Stockholm has left Yokahama to make a scientific survey of the peninsula of Kamchatka. The work will last for at least two years. The members of the expedition are from the University of Stockholm and are under the direction of Even Bergman. They are prepared for a zoological, botanical ethnographical, geological and geographical survey of the whole peninsula. The collections will be donated to the Swedish Geographical Society and to the University of Stockholm. Kamchatka is known to have a rich and varied flora and fauna, but it is comparatively unknown to scientists. The plant life is particularly interesting, as it is unusually extensive for the high latitude, and many of the forms belong to regions much farther south. Birds and animals are numerous, and as far as known are similar to those of Alaska.

UNIVERSITY AND EDUCATIONAL NEWS

The Harvard University School of Medicine has received $350,000 from the Rockefeller Foundation for the development of psychiatry, and $300,000 for the development of obstetric teaching.

Mr. M. Douglas Flattery, an American, has presented the Institute of Bacteriology at Lyons with 100,000 francs for an annual scholarship for a student who will specialize in laboratory work on the bacteriology of infectious diseases.

At the University of Minnesota Dr. W. H. Hunter has been appointed professor of chemistry and acting head of the division of organic chemistry; Dr. C. A. Mann, professor of industrial chemistry and acting head of the division of industrial chemistry; Dr. G. H. Montillon, associate professor of industrial chemistry, and Dr. R. E. Kirk, of Iowa State College, assistant professor in general chemistry.

Dr. Daniel Starch, of the University of Wisconsin, has become associate professor of psychology in the school of business administration at Harvard University.

Professor James Newton Michie, assistant professor of mathematics in the Agricultural and Mechanical College of Texas, has been appointed adjunct professor in the department of applied mathematics at the University of Texas.

P. W. Boutwell, assistant professor of agricultural chemistry at the University of Wisconsin, has been appointed associate professor of chemistry at Beloit College.

W. J. Fuller, assistant professor of civil and structural engineering of the University of Wisconsin Extension Division, has recently resigned to accept a position on the engineering staff of the Government Institute of Technology at Shanghai, China.

The *Bulletin* of the American Mathematical Society states that at the University of Berlin, Professor L. E. Brouwer, of the Univer-

sity of Amsterdam, has been appointed professor of mathematics; Professor R. von Mises, of the Dresden technical school, has been appointed professor of applied mathematics, and Dr. Issai Schur has been promoted to a full professorship of mathematics. Professor C. Carathéodory has resigned, to accept a professorship at the National University of Athens.

DISCUSSION AND CORRESPONDENCE

EFFICIENCY IN THERMAL CALCULATIONS

THERE is something wrong with the commonly accepted definitions used in calculating efficiency when applied to thermal phenomena.

Take the following case as an example. An ice-making machine is placed in a room that requires heating. Let us calculate the efficiency of the operation of heating the room. Assuming the machine to be operated by an electric motor, the heat supplied to the room consists of two parts, the heat equivalent of the electric current, and the heat withdrawn from the water in making ice. As the entire machine is located in the room, there are no losses, all friction being utilized as useful heat. We therefore have a case where the useful heat is greater than the heat we paid for, or an efficiency of over 100 per cent.

For another illustration, consider the heating of a room by an electric heater. The efficiency is 100 per cent., as all the energy of the current goes into the room. But this same current could have been used to run machinery in the room, such as fans, sewing machines, etc., that would have returned all the heat to the room eventually. Should not this additional work be considered in calculating the efficiency of the outfit?

There is one long established law that gives the clue to more suitable definitions of thermal heat units. Carnot established the fact that the efficiency of an ideal heat engine was equal to $(T_1 - T_2)/T_1$ where T_1 equals the absolute temperature of the source of heat and T_2 the temperature of the exhaust. In other words the work that it is possible to obtain from heat depends upon the difference in temperature as well as upon the calories present.

Our efficiency terms would be of more practical value if instead of using the calories we should use a modified heat unit consisting of the calory multiplied by the ratio referred to above, taking the value T_2 as the lowest temperature of the surrounding air, condenser water, etc.

This would, of course, increase the mathematical difficulties, but why say that a boiler has an efficiency of 80 per cent. when but one third of that 80 per cent. can be used by an ideal engine. This method would also bring out forcibly the tremendous losses in heating houses by coal, without making use of the power as a by-product. The inefficiency of the steam locomotive is frequently commented upon, but the inefficiency of raising the temperature of a house 10° F. is so much greater that it should be made evident to all.

There is one serious objection to the use of a ratio such as that of Carnot's cycle as part of a unit of heat. That is, is Carnot's cycle the best possible cycle? None other has been developed as yet, but we have not established the proposition that none can be developed.

ALLAN W. FORBES

WORCESTER, MASS.

IN Mr. Forbes's interesting communication, which the editor has been good enought to let me see, he has perhaps overlooked the fact that in a reversible cycle, the efficiency being defined as the ratio of work done to heat taken in for a motor, always less than unity, if the efficiency of a freezing machine or heating plant be defined as the ratio of heat taken up to work done, this will be the reciprocal of the efficiency of the motor, and consequently greater than unity. Evidently the efficiency will be greater the smaller the temperature interval to be covered. This was pointed out many years ago by Lord Kelvin, who called attention to the enormous waste in heating a house, the difference of temperature employed being that from the red heat of combustion of the coal to the temperature desired, when all that is needed is the small

range between indoor and outdoor temperatures. Lord Kelvin actually proposed to heat a house by a reversed heat engine or refrigerating machine. I am not aware whether this has actually been tried in practise.

By the efficiency of a boiler we mean the ratio of the energy, contained in the hot water and steam into which it has been converted, to the amount of heat that may be realized by burning the coal. This suffices to indicate the performance of the boiler, while that of the engine is a separate thing, and suffices to compare the performance of the engine with that of a perfect engine, limited as it is by the second law of thermodynamics. Mr. Forbes casts doubt upon Carnot's cycle being the most perfect one, but that was thoroughly proved by Carnot to be the case. In fact the gas-engine and the Diesel, which approach most nearly to the Carnot cycle, have the highest efficiency that has been attained. Mr. Forbes is correct in pointing out the fact that the efficiency of electric heating is unity, a fact which interests the consumer, who in this rare case knows that the meter can not do him an injustice, and yet, for all that, this is not a cheap method of heating. Electricity *can* compete with the ice-man.

Arthur Gordon Webster

REVERSAL OF THE SODIUM LINE

To the Editor of Science: On a recent visit to a large plate-glass factory in the vicinity of Charleston, West Va., I had the good fortune to note the reversal of the well-known sodium line "D." The instrument used was a small pocket direct-vision spectroscope, which I carry with me on technical trips.

The furnace was a 200-ton plate-glass type, gas fired; and the reversal was noted at the peep-hole near the charging end, and shortly after the introduction of a fresh charge of the "mix." The reversal was noted in the case of two furnaces, one of these giving a *steady* reversal, and one giving a *wavering* and *intermittent* reversal. The phenomenon was noted both by myself and also by three distinguished technical friends attendant on the trip. Of course the reversal of the sodium lines is frequently observed in the electric arc, but this is the first instance in my experience that I have noted such reversal in a *fuel-fired furnace*. The temperature of the furance was probably approximately 3,000° F.

The observation may be more common in the experience and observation of others; but if this brief note should prove of value, the writer will be glad to answer any detailed questions regarding this rather unique matter. I have long held the opinion that the spectroscope has not been—and is not yet—used for its full technical worth in the practical arts.

Charles S. Palmer
United Fuel Gas Co.,
Charleston, West Va.

THE CARNEGIE FOUNDATION AND RESEARCH IN THE COLLEGES

In a paper on college government and the teacher's salary, in the 14th annual report of the Carnegie Foundation for the Advancement of Teaching, the statement is made that much of what passes for research in American universities is only imitation research, which is detracting from the quality of the teaching to which the students are entitled. The conclusion is drawn, by inference at least, that the large sums of money spent on this kind of research could be expended much more profitably in strengthening the teaching work. It is unnecessary to debate the correctness of the writer's judgment as to the quality of the research work done in the universities. A large part of the research work done everywhere is mediocre or poor and it would be surprising indeed if this did not imply also to the colleges. No doubt the work done in some institutions is inferior to that of some others just as the teaching is of different degrees of perfection. It seems, however, that the writer has entirely overlooked one aspect of research work which in the colleges should be given the most serious consideration.

For many years the appreciation of the value of research has been growing in this country. This interest has been greatly stim-

ulated by the war and is especially reflected by the demand for investigators by the industries. Obviously, if this interest is to be maintained, if indeed it is not to be seriously checked by unsatisfactory work of poorly trained men, a supply of investigators must be available, and they must come from the colleges. Of course, a student can not be taught to be an investigator. He can only be given the tools of the trade, the essential training in the fundamentals, and the opportunity to make himself into an investigator if he has the proper mental equipment. He must learn first of all that there is such a thing as research by which a livelihood and an honorable position can be gained. Through contact with research workers he must acquire that spirit which is absolutely essential to continued investigation, and without which few young men will choose the laboratory in preference to the more lucrative offerings of the business and professional world. This contact can be obtained only in colleges doing research work. Every one who has had experience in maintaining the personnel of an investigational institution knows that the chances of getting good research men is much greater in the colleges doing research work. Not only does he find there students sufficiently interested in research to consider it as a calling, but those who are temperamentally adapted to this exacting type of work have had some opportunity of demonstrating their fitness. Colleges doing no research work rarely turn out an investigator. It is improbable that the students in these institutions differ essentially from those whence most of our investigators come. The difference lies in the fact that nothing is done to develop those having qualifications for this work. Musicians are not developed in a technical school, nor artists in a college of law.

Presumably research is conducted primarily for the results it may yield, but what we usually consider as the results of university research is in reality but a by-product; the real results are the investigators it develops.

There has never been a time when the colleges were so unable to meet the demand for men to fill research positions. Under these conditions should the Carnegie Foundation attempt to discourage research in the universities, or should it use its great resources and power to strengthen the weak places it has found?

L. A. ROGERS

WASHINGTON, D. C.

RADICALISM AND RESEARCH IN AMERICA

IN a communication by Neil E. Stevens having the title "Radicalism and Research in America" printed in the last issue of SCIENCE, both the title and the purport of the article seem to challenge comment as a form of veiled propaganda such as is all too common at the present time. When radicalism is now pretty clearly identified with bolshevism, I.W.W.ism and other similar yearnings after dictation by the proletariat styled pure democracy, and when these eruptions within the body politic are threatening to overthrow our established system of representative (not democratic) government, the claim is set up through insinuations rather than by direct assertions that the fathers of our government, Washington, Adams, Jefferson, Franklin and Madison, were all radicals identified with such tearing-down movements. It seems further to be implied that because they encouraged science, therefore scientific men need have no fear that such overturns as our radical now propose will be other than advantageous to them.

If I have misinterpreted the purport of the article I trust that Mr. Stevens will explain just what *radicalism* connotes in his communication.

WILLIAM HERBERT HOBBS

ANN ARBOR, MICHIGAN,
July 10, 1920

[Dr. Stevens writes that he does not wish to reply to Professor Hobbs, but that he has no objection to a quotation from a personal letter to the editor in which he says: "I used the word 'radicalism' in what I believed to be its correct sense as established by good usage, as Dr. True uses it in the opening paragraph of his article 'Thomas Jefferson

in Relation to Botany' (*Scientific Monthly*), and as Henry Jones Ford uses it in 'Radicalism in American Poltics' (July, *Yale Review*), in the first paragraph of which he refers to Madison and Franklin as radicals. The word can not possibly be regarded as synonymous with, or identified with, Bolshevism, I.W.W., or anarchy." Ed.]

ANATOMICAL LITERATURE

Professor Erich Kallius (Anatomisches Institute, Breslau, Germany), who has taken over the editorship of the Anatomische Hefte and Ergebnisse der Anatomie und Entwicklungsgeschichte, writes that it is difficult now to obtain foreign literature and that he would be very glad if American contributors would send reprints as freely as possible for the use of these journals.

H. V. Wilson
University of North Carolina, Chapel

SCIENTIFIC BOOKS

Greek Science and Modern Science. A Comparison and a Contrast. By Charles Singer. London, Oxford University Press, 1920, 8o, 22 pp.

This lecture, inaugurating a systematic course on the history of science and of scientific ideas, was delivered at University College, London, on May 12, 1920. Its author, one of Emerson's "monks of Oxford," was a captain in the Royal Army Medical Corps during the recent war. Its object is to bridge over the embarrassing gap between the history of Greek science and that of modern science. It is a commonplace to deride the Middle Ages for sterility in science; the thing is to ascertain just how, where and why they were sterile. This department of historical investigation Singer defines as "the pathology and embryology of human thought"; for, in the Middle Ages, Greek science did slowly and surely die, and strange as it may seem, our modern scientific methods were actually engendered, by lengthy and painful travail, out of medieval restrictions.

Of this view of things, Dr. Singer's lecture gives a clear and intelligible account. The argument is as follows: It is one of the vainest delusions of the modern mind to imagine that we can entirely enter into the modes of thought of the ancient Greeks. This fact, which Singer has frequently insisted upon in private correspondence, was already emphasized long ago in the verses of one who was very close to them, the Roman Lucretius.

> Nec me animi fallit Graiorum obscura reperta
> Difficile inlustrare Latinis versibus esse,
> Multa novis verbis præsertim cum sit agendum
> Propter egestatem linguae et rerum novitatem.

But it is at least reasonably certain that the Greeks based their scientific system upon Egyptian, Minoan and Assyro-Babylonian tradition, that this pre-Hellenic material was an anonymous, socialistic, collectivistic product; while the Greeks thought as individuals, not as a people, stamping their work, each one of them, with his own individuality, thus giving to science the eponymous character which it has since retained. We have only to think of Diophantine algebra, Euclidian geometry, the *corpus Hippocraticum* of Galenical remedies. Credulous and facile of generalization as were the Greeks, they had yet an abiding intuitive conviction that "order reigns in nature"; that behind the observed and observable phenomena there is an ascertainable law which correlates them and is their *raison d'être*. It is just this sense of law in nature and of the necessity for personal scientific investigation that is their most valuable heritage to posterity. This is what Sir Henry Maine meant when he said that "Nothing moves in the modern world which is not Greek." In the Middle Ages, the reckless freedom in speculation as to the causes of things which the Greeks enjoyed was suppressed by prince and prelate as subversive of the feudal theory of the state and of the theological view of the universe. But, in spite of the harm it has done, there was, in Singer's view, a distinct advantage in all this. It got the practical scientific worker away from sterile speculation and down to brass tacks; so that gunpowder, printing, the mariner's compass, spectacle lenses were immediately taken up, and the outcast, outlawed medieval

surgeon was forced to become a more practical bedside man than the top-heavy scholastic internist. The Levitical code of sanitation (isolation of suspects in eight contagious diseases), and Hindu (non Roman) surgery also gained a status. Modern science differs from Greek and medieval science, however, not so much in aims or results, as in processes and methods; and here we have "certain new factors of an order the world has not before seen." Except in the mathematics, the essence of which is to give steps and processes, the Greek scientist gave only conclusions and concealed his proofs, his findings being in the Lucretian phrase "*obscura reperta*." Concerning this, Singer says (p. 20):

> Ancient mathematics, like everything else that has come down to us from antiquity, have of course suffered from the accidents of time, but the obscuring power of time is a mere light veil compared to that heavy impenetrable curtain that the Greeks have themselves drawn over their biological works.

The medieval scientists (witness the alchemists or Leonardo's mirror-written physiology) had the same tendency. But we pride ourselves upon the fact that our scientific monographs are devoted mainly to definite proofs of the author's propositions. The Greeks had no instruments of precision because, being speculative philosophers, they felt no necessity for proofs. Thus, while mathematics, however interrupted by the Dark Ages, is a scientific continuum, medieval science, like Greek science, is too frequently a solution of continuity, while the continuity of modern science is insured by simple preservation of records. The only danger threatening modern science, as Singer sees it, is in the isolation of scientific workers through the extreme and complex specialization of their subjects, making one branch of science unintelligible to the followers of another. The best way to obviate this danger is through the broad study of the historical evolution of science as such, for this "experimental" method will evade the pitfalls which befell Whewell and Comte, viz., the arbitrary concept of a rigid orthodoxy in science, based upon a quasi-medieval hierarchy of all the sciences. The history of science is not secular or sociological history, but the cultural history of mankind, the bases of which are anthropology and psychology. Through this branch of study we may clarify our own concepts, document and preserve our records, correlate our findings and so establish a continuum with the future and the past.

The finely wrought argument (Singer at his best) concludes with the thought, familiar to us in certain well-known verses of Lucretius, that the distinctive hope and glory of the science of our age is "that it will place in the hands of the inheritors of our civilization and our thought, whoever they may be, an instrument that will enable them to carry on our work from the point at which we leave it." No one can read this inspiring lecture without a heightened, clarified perception of the superior worth of modern science and the dangers which beset it. In the lecturer's own words:

> Our scientific system, of its nature, claims an independence of all race, nationality or creed. It is of all studies the most truly international. The scientific man may, better than most, claim with St. Paul that he is a citizen of no mean city, that he is the true citizen of the world.

F. H. GARRISON
ARMY MEDICAL MUSEUM

SPECIAL ARTICLES

THE PRODUCTION OF ARTIFICIAL HERMAPHRODITES IN MAMMALS

DURING the last ten years especially, there has been a decided impetus towards the analysis of sexual conditions, in animals, that has largely centered itself around a study of the physiology of the sex glands by means of transplantation experiments. From 1910 to 1913 Steinach reported his remarkable results obtained from sex gland transplantation in which one sex gland had been transferred to young castrated animals of the opposite sex (rats and guinea-pigs). The results in brief were: (*a*) masculinization of female animals by implanted testes (*i. e.*, the young female animal, after receiving the transplant, developed into a male-like animal as indicated

by somatic changes—weight, length, skeletal changes, hair coat—as well as by psychic behavior—temperament, and reactions toward animals of the opposite sex); and (*b*) feminization of young male animals by the implantation of an ovary, with corresponding results.

One point of especial interest, in this work, is in reference to the apparent antagonism of the sex glands (considered as hormone antagonism) when brought together in the same individual. Steinach was unable to obtain either a growth or persistence of an implanted sex gland *unless the gland of the host (gland of the opposite sex) was removed before the implantation was made.*

Following Professor Lillie's study of the free-martin, and at his suggestion, I began in 1916 a study of the interrelation of the sex glands that very soon led to a reinvestigation of the conditions considered by Steinach. In his study of cattle twinning, Lillie found that in a very large percentage of cases the twin fetal circulations are connected through an anastomosis of the allantoic blood vessels, as a result of the fusion of the chorionic vesicles. In correlation with such a condition, and only when the twins were male and female, the ovarian development was suppressed in the female of the pair; also, in many cases, there was an apparent superposition of male secondary sex organs upon the "determined" female sexual condition. In offering an explanation of this unique condition, Lillie suggested the possibility of a hormone antagonism with a dominance of the male secretion[1] (*i. e.,* theoretically a secretion of the testis, carried in the blood from the male to the female of the pair, may be responsible for the accompanying abnormal condition found in the female); the development of the male sexual apparatus suffers not at all from the unusual condition. If the twins are homosexual—*i. e.,* two males or two females—the reproductive system of each is entirely normal.

I have previously reported[2] the progress of the investigation undertaken and have offered a few criticisms of Steinach's conclusions. The immediate cause for this preliminary report, upon other aspects of the problem, is the appearance of a paper by Knud Sand[3] relative to the possibility of obtaining a persistence or growth of both kinds of sex glands in the same host without any apparent ill effect to either gland (a hermaphroditic condition); this paper is practically a summary of a larger monograph published in Danish.

Sand, on the whole, supports the work of Steinach but has reflected some discredit on the idea of sex gland antagonism. In a later paper Steinach reported having succeeded in obtaining subcutaneous growth of both kinds of sex glands *when these were grafted simultaneously on the same infantile castrated male animal,* and Sand, repeating the same technic, obtained an hermaphrodite animal both somatically (both glands persisted, and the rudimentary mammary glands of the male animal underwent considerable hypertrophy) as well as psychically (the animal is described as behaving both as a male and as a female). He also implanted an ovary within the substance of a testis ("Ovario-testis") and obtained a (normal) persistence of both glands. It is difficult, however, to clearly understand all of the statements in this paper, for after describing such a persistence of an ovarian graft within a testis which he claims has been left "in their natural position," he asserts that:

> *Neither did I ever succeed in a real ingrafting of the heterological gland on non-castrated animals,* whereas there was, as mentionel before, a positive result if the gonads had immediately been brought under somewhat the same conditions by simultaneous transplantation on the same animal, or by the intimate union formed by the production of ovario-testes.[4]

Sand also agrees with Steinach in his ideas of psychical changes as a result of gonad transplantation into previously castrated young animals of the opposite sex; he uses as a criterion of sex his interpretations of certain features of the behavior of such an animal.

[1] F. R. Lillie, *Jour. Exp. Zool.,* Vol. 23, 1917.

[2] C. R. Moore, *Jour. Exp. Zool.,* Vol. 28, Nos. 2 and 3, 1919.

[3] *Jour. of Physiology,* Vol. 53, December, 1919.

[4] Italics mine.

In my former papers I have discussed certain factors used as definite indicators of maleness and femaleness, and have attempted to point out the difficulty of properly interpreting the observations. With considerable reticence I was inclined to give some weight to psychical behavior in cases of the most extreme type of reactions; but I wish again to emphasize the absolute unreliability of closely graded indications of psychical behavior of rats and guinea pigs as an indication of their sexual nature. It is, in my opinion, going to an extreme when one asserts as does Sand:

> This somatic hermaphroditism was combined with a decided bisexualism of the psycho-sexual character, in that the animal showed, *even durtng the course of a single hour, momentary change from female to a decided male character,* according to the animals (males, newly-born young ones, females) with whom it was brought into contact.[5]

Sand's general conclusions in reference to sex gland growth seem entirely superfluous in the light of my own results. In explaining his failure to obtain growths of ovarian grafts in *non-castrated infantile* male animals he assumes a rather indefinite type of "Immunity" on the part of the host, towards the implanted tissue, and explains it as follows:

> In every organism are found certain substances which are necessary for the sexual glands, and these substances the latter try to obtain to the greatest possible extent. The normally situated non-transplanted gonads have the best chance of being able to absorb these substances, for which reason heterological (perhaps also homological) gonads, transplanted on normal organisms, can not get enough of these substances and therefore perish. Homological and heterological gonads, which have been transplanted at the same time to the same organism, are both able to grow in, having both about the same opportunity of absorbing the substances.
>
> Further the phenomenon that ovaries ingrafted in the testes find good conditions for developing there, can probably be explained by a similar theory, in that the substance of the normal male organism, necessary for the gonads, are perhaps stored up in the testes, both kinds of gonads thus being able to make use of them.

[5] Italics mine.

So far as the persistence and growth of rat gonads is concerned, this theory is entirely unnecessary for I have been able to obtain growths of ovarian grafts, subcutaneously, intra-muscularly, and intra-peritoneally, and without difficulty, in young male rats one of whose sex glands was intact and normal.

This part of my work was begun in 1917 and some animals bearing transplants are still living; but a detailed account of this work is nearing completion and will appear as the third paper of a series "On the Physiological Properties of the Gonads as Controllers of Somatic and Psychical Characteristics."

I have obtained persistence of both types of sex glands grafts after transplantation into young animals of the opposite sex, one of whose sex-glands had been removed to furnish material for other grafts, while the second gland of the host remained undisturbed. In the case of the ovary, the graft, after persisting eight and one half months in a male animal with an intact testis, presents all the features of a normal ovary of similar age excepting corpus luteum tissue and the presence of a larger number of atretic follicles. Normal follicles of all sizes are present—primordial follicles, more mature ones showing the beginning of the follicular cavity, mature follicles, and even those showing polar body formation in the ovum. The follicles seem not, however, to go on in their normal behavior to ovulation and corpus luteum formation, but undergo atresia. The fate of a follicular mass can be traced to its complete conversion into interstitial material. In this behavior of the follicles of the grafts, they are very similar to corresponding structures of the young female sex gland before the age of sexual maturity.

With the testicle grafts the results are not quite so striking due to the fact that mammalian testis transplantations, without exception so far as I am aware, results in the loss of the germinal epithelium. The grafts resemble considerably a cryptorchid testis in that both retain the well-rounded seminiferous tubules, but all that remains of a cellular character are Sertoli cells. The same disappear-

ance of the germinal epithelium, however, has been noted in case of ligation of the vas deferens without further disturbance of the testis. The testis graft does persist after transplantation in a female, with an intact ovary, and it is as normal as autoplastic testicular grafts, either with or without previous castration.

These observations show definitely that a sex gland can be successfully transplanted to an animal of the opposite sex which retains one normal gonad. Positive cases are of much more significance than any number of negative cases and leave no question as to whether the two glands can exist in a functional condition within the same organism at the same time. A male rat with one testis will function as a normal male during the time it is carrying two ovarian grafts as an integral part of its somatic structure; both of these grafts remain essentially normal, showing all grades of maturity of follicles, even after existence, in the subcutaneous tissues of the male, of eight and one half months.

A discussion of these observations will be taken up more fully when the completed work appears.

Carl R. Moore
The University of Chicago

STATIC REJUVENATION

For several years the writer has been making a systematic detailed study of the driftless area of southern Indiana, and has now in preparation a paper on the physiographic development of the Knobstone cuesta region lying between the Muscatatook and Ohio rivers. This particular region offers one or two problems of more than local interest, and the interpretation of one of these will be briefly stated here.

It appears that some time about the middle of the Tertiary the entire region was reduced to a peneplain (Highland Rim, or Lexington peneplain). The region was then rejuvenated by uplift. Dissection of the uplifted peneplain followed. Dissection was fairly complete near the major streams, and, in the regions of soft rocks, local areas were reduced to base-level. These locally reduced plains indicate that the uplift amounted to something like 175 feet. The region was again uplifted and dissection was renewed or continued. The Tertiary uplifted peneplain is now represented by remnants which are as much as 300 to 500 feet above the present local base-level. The New Albany shale and the lower part of the Knobstone areas were reduced to a lowland in contrast to the region west of the Knobstone escarpment. The lowland plain, stretching north from Louisville consists of a flat to undulating plain varying from 430 feet in the valleys near the Ohio River to something like 600 feet in elevation on the low divide between Silver Creek and the tributaries of the Muscatatook River. Since there are a large number of hills and flat interstream tracts at an elevation of about 500 feet at the south and coming up to about 600 feet near the above mentioned divide to the north, it has been stated that a local peneplain was formed at that level.[1] The writer concurs in the belief of a base-leveled plain of local area, and that its further development was terminated by rejuvenation. The rejuvenation, however, was not necessarily brought about by uplift. The dissection of the plain was very likely brought about by drainage changes made near the beginning of the Pleistocene. The present Ohio River is a large stream made up of a number of former drainage basins which were more or less destroyed or deranged by combination into a large major stream approximately skirting the outer limits of glacial advance. A very much smaller stream than the present occupied this territory near Louisville. It was able to reduce the area of soft rocks nearly to base-level, but it had a much steeper gradient than the much larger present Ohio. When the present Ohio invaded the basin of the much smaller pre-glacial stream the local peneplain was statically rejuvenated, due to the sinking of the larger stream into the plain on account of its ability to possess a much lower gradient in its grade condition. Such

1 Chas. Butts, "Geology of Jefferson Co., Ky.," Ky. Geological Survey, 1915, pp. 201–203.

a rejuvenation is here called *static rejuvenation.*

It may be further stated that the region of the Muscatatook River to the north still possesses just such a local base-leveled plain that existed in the New Albany locality. It is inferred that the stream which the Ohio dispossessed was somewhat near the size of the Muscatatook-White River. This stream possesses a gradient in its graded condition slightly less than one foot to the mile, while the Ohio has a gradient below New Albany slightly less than three inches to the mile. It would appear than such a change in gradient would allow a trenching of something like 90 feet, which is approximately the amount of the dissection of the local peneplain in the vicinity of New Albany, using the flood plain as the present local base-level. This figure is derived by taking the difference between the gradients of the Ohio and its assumed predecessor from New Albany to Cannelton, a distance of approximately 120 miles. In the lattitude of Cannelton valley filling begins to be rather conspicuous, and this nullifies any difference in the gradients of the former and the present streams, assuming that the valley filling of southwestern Indiana and associated regions took place during the pleistocene. A still further check both on the postulated static rejuvenation and its amount is found in the peculiar gradients of the streams emptying into the Ohio between New Albany and Cannelton. The gradients are approximately as high in their lower reaches as in their middle and upper courses. This is conspiciously true of Blue River and Indian Creek. Other complications however, enter into the full explanation of these peculiar gradients, making this a problem in itself.

The above statement of the conditions and such an explanation are ventured here for the first time. It is thought that the principle of static rejuvenation may have a wider application than the case here given. The writer would further suggest that its application be made in certain piracy cases.

CLYDE A. MALOTT
INDIANA UNIVERSITY

THE AMERICAN CHEMICAL SOCIETY.

II

COLLOID SYMPOSIUM

W. D. Harkins and Harry N. Holmes, *Joint Chairman*

Some practical applications of colloid chemistry: JEROME ALEXANDER.

Gelatinous precipitates: WILDER D. BANCROFT.

The colloid chemistry of soaps: MARTIN H. FISCHER.

Vegetable tanning as a colloid chemical process: JOHN ARTHUR WILSON. Vegetable tanning is the reaction taking place between the collagen of hide and the water-soluble matter extracted from certain vegetable materials and known as tannin. Collagen is not built up of individual molecules, but of chains of atoms forming a three-dimension network with interstices sufficiently large to permit the passage of all ordinary molecules and ions. Under the conditions obtaining in practise, collagen has a positive electrical charge and the solution absorbed in the interstices has a difference of potential against the unabsorbed portion of the tan liquor. The tannin particles are negatively charged and the thin film of solution immediately in contact with the surface of the particles has a potential difference against the bulk of the tan liquor, but of sign opposite to that in the case of collagen. This surface film of solution and the solution absorbed by the collagen tend, therefore, to merge, and when this occurs, the positively charged collagen and negatively charged tannin neutralize each other by combination, forming leather. The fact of practical importance is that the potential differences referred to, and therefore the rate of tanning, can be altered without necessarily altering the absolute values of the electrical charges.

Ceramic processes associated with colloid phenomena: A. V. BLEININGER. Clays are mixtures of finely divided aluminum silicate, of the type $Al_2O_3 2SiO_2 2H_2O$ with granular matter, such as quartz, feldspar, mica, etc., and other colloids like ferric oxide and hydroxide. The particles are of the magnitude of 5μ, or smaller. Clay suspended in water is affected in a pronounced manner by alkalies, salts and acids. The former tend to deflocculate it, the latter two cause coagulation. Both phenomena occur in phases. Absorption of the basic ion of salts is characteristic, the acid ion remaining in the dispersing medium. Deflocculation is employed in the purification of clays and in the casting process. Measurements of the fluidity

of clay suspensions offer the most convenient means of detecting the change caused by the presence of reagents, though the distinction made by Bingham between viscous and plastic flow must be kept in mind. In the firing of clay, contraction of the external volume takes place due to the effect of surface tension and the lowered viscosity upon heating. With maximum contraction and closing of the pore space the state of vitrification is reached. The mass of the clay itself undergoes expansion upon heating irrespective of the external contraction. The relation between temperature, time and contraction is a most valuable one for expressing the heat work done upon clays and other silicates and oxides. Vapor pressure likewise is a probable factor in the condensation of substances like magnesia, coal, carbon, etc., or in mixtures of inert oxides with those of higher vapor tension. The end result of the heating process tends toward the partial elimination of the colloid and the substitution of the anisotropic phase.

Surface energy: W. D. Harkins.

Nomenclature in colloid chemistry. A plea for reform: Arthur W. Thomas.

ORGANIC DIVISION

E. Emmet Reid, *Chairman*

Rodger Adams, *Secretary*

Methyl amines from carbinol and ammonium chloride, equilibria involved: W. D. Turner and A. M. Howald. Ammonium chloride and carbinol with and without the addition of fused zinc chloride were maintained at elevated temperatures in steel bombs by immersing in the vapors of constant boiling liquids. The products were analyzed for the three methyl ammonium chlorides, ammonium chloride and carbinol. Using zinc chloride as a dehydrating agent, mono-methyl ammonium chloride was obtained up to 50 per cent. of the ammonium chloride present di-methyl ammonium chloride up to 10 per cent. and tri-methyl ammonium chloride up to 4 per cent. of the ammonium chloride present. The methods of separation and estimation of the four bases are given together with tables of the equilibria reached, a summary of the results obtained and a brief bibliography.

The synthesis and physical constants of benzene and toluene sulphonamides: K. K. Kershner and W. D. Turner. The sulphonamides of benzene and toluene are prepared synthetically from benzene and toluene. This is accomplished by sulphonating the benzene and toluene, forming the sodium salt by the addition of sodium chloride, preparing the sulphonchloride by means of phosphorus pentachloride, and securing the sulphonamide by treatment with concentrated ammonia. Duplications of this process are made and comparative data taken on the yields of the different compounds formed at the conclusion of each step of the synthesis. The sodium salts are purified by centrifuging and by recrystallization from alcohol and the sulphonamides by centrifuging and by recrystallization from both concentrated ammonia and alcohol. Solubility data at different temperatures is taken on the sodium salts of benzene and toluene and on their corresponding sulphonamides with reference to absolute alcohol and pure water. A summary, giving the salient points of the work, and a bibliography, covering the literature on the subject, are given.

A sulphide alcohol: T. C. Whitner, Jr., and E. Emmet Reid. By action of ethylene chlorhydrin on sodium salt of butyl mercapton the alcohol

$$CH_3CH_2CH_2CH_2SCH_2CH_2OH$$

is obtained. This alcohol and its esters and halide derivatives have been studied and shown to be quite similar in many properties to the higher alcohols of about the same molecular weights.

A sulphide acid: K. Uyeda and E. Emmet Reid. By action of sodium chloracetate on sodium salt of butyl mercapton the acid

$$CH_3CH_2CH_2CH_2SCH_2COOH$$

is formed. This acid is readily obtained and is found to be similar in properties to the parafine acids of about the same molecular weight. The methyl, ethyl, prophyl and butyl esters and a number of salts of this acid have been prepared.

Heterocyclic compounds of n-arylamino alcohols: R. E. Rindfusz and V. L. Harnack. (1) Cyclic nitrogen compounds may be formed by the dehydration of *N*-arylamino alcohols. (2) Where six-membered rings may be so formed, the dehydration takes place closing a side ring into the benzene nucleus. (3) Where a five-membered ring would be formed as a side ring annealed to the benzene nucleus, the preference is to form a six-membered ring outside. This is unlike the behavior of analogous oxygen compounds. (4) The reaction of nitrogen compounds has not been carried out in enough cases to show that these inferences are general.

The automatic separator in organic preparations: I. N. HULTMAN, ANNE W. DAVIS and H. T. CLARKE. Principle of automatic separator. Separation of butyl alcohol or amyl alcohol and water. Steam distillation of aniline and similar liquids. Preparation of anhydrous oxalic acid, butyl ether, butyl oxalate, trimethylene chlorohydrin, and glycerol dichlorohydrin.

Some condensed rings containing arsenic: W. LEE LEWIS and W. V. EVANS. Oxydiphenylene chlor arsine is prepared by a modification of Pope's method condensing diphenyl ether and arsenic chloride in the presence of aluminium chloride. With the Grignard reagent mixed arsines of the type oxydiphenylene ethyl arsine are obtained. The brom, iodo, cyan, sulphocyan and hydrosulphide derivatives were prepared. Chlorination gave oxydiphenylene trichlorarsine which on careful hydrolysis gave the oxychloride. Bromination with subsequent hydrolysis yielded oxydiphenylene arsenic acid and its metal and alkaloidal salts. The condensation of diphenylmethane and diphenyl sulfide with arsenic chloride is being studied.

A cooperative pamphlet on organic chemical preparations: ROGER ADAMS, O. K. KAMM, H. T. CLARKE, J. B. CONANT. An annual pamphlet is to be published containing the detailed directions for the preparation of various reagents which may have been produced in the laboratories in which the above authors work. The directions are to be tested out in one of the other laboratories and not until the results can be duplicated are they to be published. A discussion of the reaction and bibliography of other methods of preparation are included. It is hoped that others who may be carrying on investigations in organic research will be willing to contribute methods of preparation for various reagents which they may have developed in detail in their laboratories. These will be tested out and published with the others.

The reaction between aldehydes and acid halides: ROGER ADAMS, H. E. FRENCH and L. H. ULICH. It has been shown that the reaction between aromatic acid halides and aliphatic or aromatic aldehydes and between aliphatic acid halides and aliphatic aldehydes to give compounds of the general formula RCOOCHXR is very general. Early work in this field showed that a number of aliphatic halides and aldehydes reacted together to give compounds of this type but until the above research was undertaken no substances were obtained between aromatic acid halides and aliphatic aldehydes with the exception of the compounds from benzoyl chloride and formaldehyde and no compounds from aromatic acid halides and aromatic aldehydes were produced with the exception of the compound from benzoyl bromide and benzaldehyde. The reaction between aliphatic acid halides and aromatic aldehydes does not seem to run so smoothly and results are not yet available on this point. These halogenated esters that are produced react in many cases merely like a mixture of the acid halides and aldehydes. In other cases, the halogens react like the halogens in alkyl halides.

The preparation and physiological action of oxazolidones and their decomposition into substituted B-amino ethyl alcohols: ROGER ADAMS and J. B. SEGUR. The oxazolidones are readily produced by condensing phosgene with ethylene chlorohydrin to give beta-chloroethyl chlorocarbonate. This is condensed with aniline to give the corresponding urethane derivative and then by treatment of this latter substance with alkali, the oxazolidone is produced as follows:

$$ClCOOCH_2CH_2Cl \rightarrow C_6H_5NHCOOCH_2CH_2Cl \rightarrow C_6H_5N\underline{\quad}COOCH_2CH_2.$$

If the oxazolidone is treated with excess of concentrated alkali or if the urethane derivative is treated directly with excess of concentrated alkali, very good yields of N-aryl amino alcohols are produced.

$$C_6H_5N\underline{\quad}COOCH_2CH_2 \rightarrow C_6H_5 - NHCH_2CH_2OH.$$

The paraethoxy phenyl oxazolidone has about the same toxicity as phenacetin and as an antipyretic possesses slightly greater value than phenacetin.

CHARLES L. PARSONS,
Secretary

(To be continued)

THE NORTH CAROLINA ACADEMY OF SCIENCE

THE nineteenth annual meeting of the North Carolina Academy of Science was held April 30 and May 1, 1920, at the North Carolina State College of Agriculture and Engineering, West Raleigh, N. C. At the same time the spring meeting of the North Carolina Section of the American Chemical Society was held.

Among the more important business matters discussed and acted upon were those relating to the affiliation of the academy with the American Asso-

ciation for the Advancement of Science, the decision of which rests with the executive committee with power to act; and the matter of seeking state support from the next legislature which was left in the hands of the executive committee for action and if found favorable the president was authorized to appoint a committee to approach the legislature in an effort to obtain $1,000 per year to be expended for publications and the furthering of research work.

A total of twenty-eight new names was added to the membership list. The membership now includes 113 individuals interested in science in North Carolina.

The following officers were elected for the year 1921:

President: Z. P. Metcalf, professor of zoology and entomology, State College, West Raleigh, N. C.

Vice-president: J. M. Bell, professor of physical chemistry, University of North Carolina, Chapel Hill, N. C.

Secretary-Treasurer: R. W. Leiby, assistant entomologist, research, State Department of Agriculture and Agricultural Experiment Station, Raleigh, N. C.

Additional members executive committee: H. R. Totten, University of North Carolina; R. N. Wilson, Trinity College; F. A. Wolf, State College, Agricultural Experiment Station.

The meeting was featured by the address of the retiring president, Dr. A. H. Patterson, who spoke on "The Einstein theory of relativity." Other papers presented were:

Functions of circular curves simplified: T. F. Hickerson.

Some biological aspects of the tidal zone region of the North Carolina coast: Z. P. Metcalf.

Recent growth and depletion of sea beaches on the North Carolina coast. (Lantern): Collier Cobb.

Some remarkable forms of the skeletal element in Lithistid sponges: H. V. Wilson.

Animal locomotion: H. H. Brimley.

Single spore cultures of Coprinus radiatus: H. R. Totten.

Genera of lower Basidoimycetes new to the United States: W. C. Coker.

Turtles of North Carolina: C. S. Brimley.

Electro-endosmosis of clays: Thorndyke Saville.

The life-history of a gall-making Psyllid Pachypsylla mamma Riley. (Lantern): B. W. Wells.

Dreams and their causes, with examples: C. S. Brimley.

A little-known vetch disease: F. A. Wolf.

Notes on the mosquito fauna of North Carolina: F. Sherman.

Agricultural geology: John E. Smith.

The larger cornstalk borer Diatraea zeacolella Dyar. (Lantern): R. W. Leiby.

The wing venation of the Heteroptera: Herbert Spencer.

An interesting fertilizer problem: H. B. Arbuckle.

A list of Cicadellidæ taken at Swannanoa, North Carolina: Z. P. Metcalf and Herbert Osborn.

A phenomenal shoot (exhibit): B. W. Wells.

A peculiar Mycorhiza-forming Rhizopogon on the roots of the pine: H. R. Totten.

Effect of fertilizers on germination and seedling growth of corn and cotton. (Lantern): M. W. Sherwin.

Behind the barrier beaches from Boston to Beaufort. (Lantern): Collier Cobb.

Some investigations on the compounds isolated from the Polypores: Joseph T. Mattox and Raymond Binford.

Effect of borax on plant growth: Oscar J. Theis, Jr., and H. B. Arbuckle.

Dyestuff situation in the United States: R. F. Revson.

New ethers: A. S. Wheeler and S. C. Smith.

Further studies on the melting points of the nitrotoluenes: Jas. M. Bell.

Vitamines—a review: W. A. Withers.

Cymene, a new solvent: A. S. Wheeler.

A color reaction for pure Cymene: A. S. Wheeler.

The conductivity of nonaqueous solutions: Paul Gross.

Some new types of distillation apparatus: Paul Gross.

R. W. Leiby,
Secretary-Treasurer

Raleigh, N. C.

SCIENCE

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